And Then There Were None

Next Generation Science Standards:

- MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Hawai'i Content and Performance Standards III:

- SC.8.2.1 Describe significant relationships among society, science and technology and how one impacts the other.
- SC8.5.1 Describe how changes in the physical environment affect the survival of organisms.

Description:
Haleakalā National Park preserves one of the only intact examples of a native Hawaiian ecosystem. This lesson will be a review of native species that live in the park. Students will play a game to explore (positive and negative) factors that impact native ecosystems and how those factors impact the populations of a species.

Duration: 45 minutes and take home project

Objectives: At the end of this lesson, the students will be able to:

- Understand that biodiversity of an ecosystem depends on many interconnected factors and that an effect on one factor can influence all the others.
- Identify endemic and endangered species in Maui and explain why native habitats are critical to the survival of these species.
- Name three reasons why people should care about the loss of endemic species.
- Describe the impacts of invasive species on the biodiversity of plants and animals in Maui.
- Determine how Haleakalā National Park protects biological diversity and describe three ways students can help too.

Background:
Hawaiian endemic species are found only here. Many are specially adapted to survive only in a very limited habitat. Because they gradually adapted to an environment without any large native herbivorous (plant eating) mammals, native Hawaiian plants generally evolved into forms lacking thorns, bad tastes or noxious chemicals. They were left with no way to protect themselves. Introduced species were brought to Hawai'i by humans. The introduction of invasive plants, rats, mongoose, cattle, goats, pig, deer, and sheep threatens the survival of many of our native species. About 20 new non-native species are introduced every year. Hawai'i is being invaded by plants and animals from all over the world and they are displacing

native species that have nowhere else to go. There are many ways that we can help to fight this major threat to our endemic biodiversity. Haleakalā National Park is at the forefront of this battle against invasive species.

Vocabulary:
Endemic: Native species that have adapted to a specific region over time and are found nowhere else.
Organism: An individual animal, plant, or single-celled life form.
Population: The number of individuals of one or more species living in a place at a given time.
Symbiotic: An interdependent relationship that benefits both organisms.

Materials Needed:

Species cards (included)
Threats and Aids list (for teacher) (2 sided, included)
1 blank sheet of paper for each student
Scissors

Procedure:

Step 1: Introduction

Copy and cut the 12 "species" cards apart and distribute one to each student. Explain that each student is an endemic plant or animal and they are specially adapted to live only here on Maui. Review the terms endemic and adaptation to check for understanding. Explain that many endemic species depend on one or more other specialized endemic species for their survival. They often are interdependent and help each other in symbiotic relationships.

Step 2: Preparation

Have each student cut apart a blank piece of paper into six even size pieces. Each slip of paper represents $1/6^{th}$ of the population of their endemic species. Each student will hold 6 slips of paper, representing the entire population of that species. The Threats and Aids List is for the teacher to read as the game progresses. Choose an area of the room for a "graveyard" for extinct species.

Step 3: Species Review

Spend some time discussing the different native plant and animal species that are on the species cards.

- **Native Plants:** ʻAʻaliʻi, Nohoanu, Pūkiawe, ʻAmaʻu, ʻĀkala, ʻIliahi, Māmane, ʻŌhiʻa lehua, and ʻĀhinahina
- **Native Birds:** ʻIʻiwi, Nēnē, and ʻApapane

Ask students if they have any questions about their species. Students will need to be somewhat familiar with their species to understand when a "threat" or "aid" will affect them. Discuss some of the threats facing Maui's endemic

species.

Step 4: Game Instructions

Tell students that you are going to be exploring what factors cause a species to become endangered or extinct? Give them the following directions:

- Everyone stand up by your desk holding your 6 slips of paper. Each slip of paper represents 1/6th of the entire population of your particular species. Each time that I read a "threat" that affects your specific species put one of your slips on your desk. Only the species affected by the "threat" should put a slip on their desk. This means that your species populations are declining.
- Whenever I say, "Human Population Growth," everyone turns in a slip. Your populations are declining again.
- Whenever I read a statement that helps your species survive from the "aid" list take a slip of paper back. This represents a population recovery (increase).
- (For an optimistic and inspiring ending: continue on using all "aid" factors to save the endangered and threatened species from the brink of disaster.)
- When you have only two slips of paper left, sit down in your chair and say. "I am threatened".
- When you have only one slip left, stay seated and say "I am endangered".
- When you are completely out of slips, move to the "graveyard" area and say "I am extinct". Extinction is final.

Continue to play until you have a mix of threatened, endangered, and extinct students. Write the words Thriving, Threatened, Endangered, and Extinct on the white board. Then write on the board the tally of the number of students (species) remaining in each category.

Step 5: Discuss and Summarize

Tell students that their populations became "threatened" when their population became somewhat small in number. They became "endangered" when their populations became so small that they were in danger of extinction. Extinction is when there are no individuals left. Extinction is final. The plant or animal is "gone forever." Summarize this lesson with a discussion. Some thought provoking discussion questions are:

- How many of you have slips left? How many have none?
- Is this game life-like? Why or why not?

- How could you find out if the species you had is actually threatened/endangered/extinct?
- Do species have any choices in how big their populations are? Why or why not?
- What are the important ideas in the game?
- What are some factors that influence the survival of populations of plants and animals?
- Can you think of some survival factors that this game did not consider?
- Do we have any control over any of these factors?

Step 6: Journal Entry

Some thought provoking journal questions are:

- How do changes in a species habitat affect their population? Give specific examples.
- Why are native habitats critical to the survival of Maui's endemic species?
- What factors affect the biodiversity of an ecosystem? When one factor changes what can happen?
- How could a species adaptations help it to survive when its environment changes? Explain using specific examples.
- How could modern technology help endangered species to survive?
- Name three reasons why people should care about the loss of endemic species.
- Describe the impacts of invasive species on the biodiversity of plants and animals in Maui. Give specific examples.
- How does Haleakalā National Park help to protect biological diversity? Name three things that you can do to help.

Step 7: Design a Park Display (Take Home Project)

You have been hired to design a park display to help inform 1,000,000 visitors per year about biodiversity in Haleakalā National Park. Research Haleakalā National Park and create a poster size display that gives solid facts about the parks biodiversity. Make sure to include lots of images in order to help visually educate park visitors.

Species Cards

ʻAʻaliʻi	ʻIʻiwi
ʻĀhinahina	Nēnē
Nohoanu	ʻApapane
ʻĀkala	Pūkiawe
ʻIliahi	ʻŌhiʻa lehua
Māmane	ʻAmaʻu

Threats	Aids
You have been poisoned by a Eucalyptus tree.	Volunteers removed a stand of Eucalyptus trees that were poisoning your roots.
Mosquitoes carry avian malaria, a disease affecting endemic bird species.	People removed debris and standing water from their yards so mosquitoes can't breed.
Feral pigs move into your habitat and trample it.	Pig hunters keep the populations of pigs down.
Pesticide spray that kills weeds, has polluted the water.	I live in a Pesticide free area with organic farmers and a clean water supply.
An invasive plant is accidently brought into Maui from a visitor.	Agricultural Inspectors at the airport catch an invasive plant that hitchhiked on a visitor's shoe.
Ants and wasps enter your habitat and attack your pollinator.	National Park Service staff set up wasp traps to catch them.
Feral cats move into your habitat.	A family of feral cats are turned in to Maui Humane Society for adoption.
People feed you food that is not from your habitat.	Visitors drive carefully and give you lots of space when they visit your habitat.

Threats	Aids
Your habitat is threatened from trees being cut down.	A group of Boy scouts planted 100 native trees in Haleakalā National Park.
Goats and sheep affect your habitat by stripping the mountainside of vegetation.	National Park Service staff and volunteers built a fence that surrounds my habitat and protects me.
Invasive plants crowd your habitat.	People remove invasive plants from their backyards.
Rats and mongoose enter your habitat and eat bird eggs.	National Park Service staff trap rats and mongoose in your habitat.
Miconia, an invasive plant, moves into your habitat and shades everything.	MISC (Maui Invasive Species Control) removed Miconia from your habitat.
Pine trees form dense, nearly impenetrable thickets that don't leave any room for you!	Student volunteers cut down non-native pine trees as a community service project.
Pollution causes the air quality in your habitat to degrade.	A wealthy land owner donated 500 acres to the National Park Service.
Water is diverted or removed from your habitat for human use.	Human use from a nearby stream is limited to help restore stream flow.